REMARKS

The application has been reviewed in light of the Final Office Action mailed December 17, 2003. At the time of the Final Office Action, claims 1-9, 11-40, 42-52 and 55-66 were pending in this application, and claims 1-9, 11-40, 42-52 and 55-66 were rejected.

Rejections under 35 U.S.C. § 103(a)

Applicant respectfully traverses the rejections and submits that the references relied upon do not teach or suggest, individually or in combination, what is being claimed in independent claims 1, 37 and 49.

A. Claims 1, 7-9, 11, 12, 25, 26, 31-34, 37-40, 42, 43, 46-52, 55-59 and 64 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,496,173 B1 issued to Albu et al., (hereinafter "Albu") in view of U.S. Patent No. 5,103,112 issued to Briggs (hereinafter "Briggs).

The present invention uses controlled amplitude and pulse-width current pulses for charging columns of a liquid crystal display to voltages representative of pixel gray scale shades. Both the current source amplitude and pulse-width are controlled in combination to achieve very high resolution of the resulting voltage charge created on the column capacitance from the amplitude and pulse-width controlled current pulse for each individual column. The current pulse characteristics (amplitude and pulse-width) may be stored in a gamma lookup table (LUT) so that the desired pulse amplitude and pulse-width for each of the desired gray scale shades of the liquid crystal display (LCD) may be selected as required by the received pixel image to be displayed on the LCD. By selectively controlling both the current pulse amplitude and the current pulse-width, much finer resolution (granularity) of the resultant column voltages may be obtained. The resolution may be the number of bits applied to the digital-to-analog converter (DAC) for a current amplitude from the DAC, represented by A, and the pulse-width

time duration of the current amplitude from the DAC, represented by T. The resolution (granularity) of the resulting current pulse used to charge the column capacitance to a desired voltage will be A x T. Thus, the voltage charge to the column is not limited to the resolution of the current DAC, and may have a much greater resolution than is possible with a DAC alone.

The Albu patent discloses a counter (12) that controls a lookup table (LUT) (32) whose output controls the output of a current source digital-to-analog converter (IDAC) (34). The output of the IDAC (34) is initially coupled to all of the LCD pixel columns (28) through current amplifier/switches (36, 38). Each of the column switches 38 has an associated comparator (24) that monitors the output of the counter (12) and predetermined counter values for each column (28) that are stored in a data buffer (22). When the digital value of the counter (12) matches a predetermined counter value for a column, the comparator (24) will turn off the respective column switch (38), thereby stopping any further voltage charge of that column (28). In effect each column stays connected to the voltage charging circuit (34, 18, 36) until a desired voltage value (*i.e.*, what is stored for that column 28 in the data buffer (22). As each voltage value for a column (28) is reached, as determined by the comparator (24), that column is disconnected from the voltage charging circuit (34, 18, 36). This operation is like a bus dropping passengers off along a well defined route (each column gets off the voltage charging bus when it reaches its desired voltage value). *See generally*, Albu, column 3, lines 11-44. The resolution accuracy of the voltage charging current source of Albu can only be the absolute resolution of the IDAC since the current charging step must equal the IDAC digital input resolution. Albu does not teach or suggest controlling both the pulse-width and the amplitude of the current charging pulse for enhanced gray scale resolution.

Albu does not address nor take into account the change in capacitance that results from a column being disconnected from the charging circuit. The current charging disclosed in Albu simply ramps up from the value of the counter (12), thus changes in connected column capacitance will greatly alter the accuracy of a voltage charge into a capacitance from a current source since voltage is dependent upon the amount of charge (current) injected into the capacitance in combination with the capacitance value. Significant errors may be introduced by changing the capacitance values while trying to charge column(s) from a current source. Also the voltage charging method disclosed in Albu has only the resolution of the IDAC (34) since pulse-width is not controlled, only the time in which a column is connected to the charging source. In contrast to what is disclosed in Albu, the present invention injects a unique current pulse, having a specific amplitude and pulse-width, for each individual LCD column. Thus the present invention takes advantage of the greater resolution of combining both current amplitude and pulse-width time duration to more finely control the amount of current charge injected into each individual column capacitance than is possible with the references relied upon. This results in many more gray scale shades available even with a relatively low input resolution DAC.

Briggs teaches a simple, low cost binary value controlled voltage source gates that may be implemented on an amorphous silicon substrate in great number due to the low cost and simplicity of the circuit. The Briggs invention is compared and contrasted with a programmable counter which is typically used for timing the on state of a gate ("width of the pulse") which allows a ramping voltage to pass through to charge an LCD element, *e.g.*, LCD column. As stated in Briggs:

> Display information represented by binary numbers are converted into variable width pulses which pulses are used to control conduction times of switching transistors. A ramp voltage is applied to one electrode of the switching transistor, the other

> electrode being coupled to a display element. The transistor is conditioned to conduct at predetermined intervals and is turned off as a function of the variable width pulse. At the time the transistor is turned off, the ramp voltage, and thus the potential applied to the display element is proportional to the binary value controlling the pulse-width.

Briggs, column 1, lines 20-31.

Briggs teaches charging a LCD element, *e.g.*, column, with a ramping voltage source until the ramping voltage source reaches a desired voltage value, then the ramping voltage source is disconnected from the LCD column. Briggs does not teach or suggest using a current source having a "controlled amplitude and pulse-width" for charging a LCD column. The present invention uses a controlled current amplitude of constant value which is coupled to the LCD column for a controlled duration of time (pulse-width). The product of the controlled constant amplitude and controlled duration of time results in a much better resolution (granularity) then what is possible with what is taught in the references relied upon.

Briggs teaches using a voltage ramp generator that is connected to an LCD element until the voltage ramp generator output has reached the desired voltage value on the LCD element. Albu also teaches using a counter (12) to drive the input of the IDAC (34). This counter input also results in the output (current) of the IDAC (34) ramping up while charging the LCD column until a value of the counter (12) is reached that matches the desired charging current value. The resolution of Albu is only that of the number of binary input bits of the IDAC (34). Albu does not teach nor suggest using a controlled current amplitude of constant value which is coupled to the LCD column for a controlled duration of time (pulse-width), as claimed in the present invention.

No motivation is found in either of the references to combine a constant amplitude current source with a controlled pulse-width since Briggs only teaches a ***ramping*** voltage source coupled to an LCD element and controlled by a certain desired pulse-width. Albu only teaches a ***ramping*** current source controlled by a count value (input to the IDAC) being reached then the current source is de-coupled from the LCD column being charged. Neither of the references, individually or in combination, teach or suggest the new, novel and non-obvious feature of the present invention which is controlling both the amplitude of a constant value of current and the pulse-width (time duration) of that constant amplitude current pulse to uniquely charge each of the respective columns of an LCD, as claimed in independent claims 1, 37 and 49. Claims 7-9, 11, 12, 25, 26, 31-34 and 64 depend from independent Claim 1 and contain all limitations thereof. Claims 38-40, 42 and 46-52 depend from independent Claim 37 and contain all limitations thereof. Claims 50-52 and 55-59 depend from independent Claim 49 and contain all limitations thereof.

B. Claims 2-4, 27 and 28 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Briggs, and further in view of U.S. Patent 6,459,395 issued to Yoshitoshi Kida et al. (hereafter "Kida").

Kida merely teaches column and row selection in a LCD. The references relied upon do not teach or suggest, individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge, at a very fine resolution, each of the respective columns of an LCD, as discussed above. Claims 2-4, 27 and 28 depend from independent Claim 1 and contain all limitations thereof.

C. Claims 5, 6, 29, and 30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Briggs and Kida as applied to Claim 2 above, and further in view of U.S. Patent 6,067,083 issued to Glen et al. (hereinafter "Glen").

Glen teaches saving power by turning off a video graphics processor during horizontal and vertical retrace times in an analog cathode ray tube (CRT) video display. Glen also teaches a look-up table DAC for use with the CRT display. There is no teaching or suggestion to apply the Glen invention to an LCD (LCD is digitally controlled, not analog and does not require horizontal and vertical retrace times). Kida merely teaches column and row selection in a LCD. None of the references relied upon teach or suggest, individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an LCD, as discussed above. Claims 5, 6, 29 and 30 depend from independent Claim 1 and contain all limitations thereof.

D. Claims 13, 14, 44, and 45 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Briggs as applied to Claims 1 and 37 above, and further in view of U.S. Patent 5,970,106 issued to Masanori Izumikawa (hereinafter "Izumikawa").

Izumikawa teaches a phase-locked-loop (PLL) clock system. There is no teaching nor suggestion to use the Izumikawa invention in a LCD to control a current pulse amplitude and pulse-width for charging a LCD column voltage. Likewise there is no suggestion to combine the PLL of Izumikawa with the other references relied upon to control the amplitude and pulse-width of a current source used to charge individual LCD columns to specific voltage levels, nor do the references relied upon teach or suggest the high resolution gray scale shade selection possible when using the present invention. Claims 13 and 14 depend from independent Claim 1 and contain all limitations thereof. Claims 44 and 45 depend from independent Claim 37 and contain all limitations thereof.

E. Claims 15-18 and 35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Briggs as applied to claim 1 above, and further in view of U.S. Patent 5,453,991 issued to Kouhei Suzuki et al. (hereinafter "Suzuki").

Suzuki teaches internal integrated circuit inspection circuitry that is directed to wafer-level inspection. There is no relationship to LCD column voltage charging, nor is there any motivation to combine Suzuki with the other references relied upon to teach or suggest controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an LCD to specific voltage levels, as discussed above. Nor do the references relied upon teach or suggest the high resolution gray scale shade selection possible when using the present invention. Claims 15-18 and 35 depend from independent Claim 1 and contain all limitations thereof.

F. Claims 19-21, and 60 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of U.S. Patent 5,668,650 issued to Hisatoshi Mori et al. (hereinafter "Mori").

Mori teaches an internal amorphous thin film transistor (TFT) structure that internally compensates for the gate-source capacitance Cgs of each TFT. None of the references relied upon teach or suggest, either individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an LCD, as discussed above, to specific voltage levels or the high resolution gray scale shade selection possible when using the present invention. Claims 19-21 depend from independent Claim 1 and contain all limitations thereof. Claim 60 depends from independent Claim 49 and contains all limitations thereof.

G. Claims 22, 23, and 36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Mori as applied to Claims 19-21 above, and further in view of U.S. Patent 6,081,250 issued to Takayuki Shimada et al. (hereinafter "Shimada").

Shimada teaches a method to reduce the effect of column and row delay times by doubling the number of columns and rows, and modifying the signals used in them. This method is not relevant nor required for the present invention. None of the references relied upon teach or suggest, either individually or in combination, what is being claimed. Claims 22, 23 and 36 depend from independent Claim 1 and contain all limitations thereof.

H. Claim 24 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Briggs and Mori as applied to Claims 19-21 above, and further in view of U.S. Patent 3,538,450 issued to J. J. Andrea et al. (hereinafter "Andrea").

Andrea teaches using a varactor capacitor to electronically control the frequency of an oscillator. There is no teaching nor suggestion in Andrea for what is being claimed. None of the references relied upon teach or suggest, either individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an LCD to specific voltage levels or the high resolution gray scale shade selection possible when using the present invention. Claim 24 depends from independent Claim 1 and contains all limitations thereof.

I. Claims 61-63 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of U.S. Patent 5,940,057 issued to Lien et al. (hereinafter "Lien").

Lien teaches solving crosstalk in amorphous silicon TFT displays be line inversions and pre-charging of the display electronics. This is not required nor desired in the present invention. There is no suggestion to combine Lien with the other references relied upon to teach or suggest, either individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an

LCD to specific voltage levels or the high resolution gray scale shade selection possible when using the present invention. Claims 61-63 depend from independent Claim 1 and contain all limitations thereof.

J. Claims 65 and 66 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Albu in view of Mori et al. as applied to Claim 19 and 20 or as applied to Claim 60 above, and further in view of U.S. Patent 6,151,238 issued to Willem Smit et al. (hereinafter "Smit").

Smit teaches using flusable links to adjust capacitance. However, Smit in combination with the other references relied upon do not teach or suggest, either individually or in combination, controlling both constant amplitude current pulses and pulse-widths thereof to uniquely charge each of the respective columns of an LCD to charge individual LCD columns to specific voltage levels or the high resolution gray scale shade selection possible when using the present invention. Claim 65 depends from independent Claim 1 and contains all limitations thereof. Claim 66 depends from independent Claim 49 and contains all limitations thereof.

All amendments are made in a good faith effort to advance the prosecution on the merits. Applicant reserves the right to subsequently take up prosecution on the claims as originally filed in this or appropriate continuation, continuation-in-part and/or divisional applications.

Applicant respectfully requests that the amendments submitted herein be entered, and further requests reconsideration in light of the amendments and remarks contained herein.

Applicant respectfully requests withdrawal of all objections and rejections, and that there be an early notice of allowance.

SUMMARY

In light of the above amendments and remarks, Applicant respectfully submits that the application is now in condition for allowance and early notice of the same is earnestly solicited. Should the Examiner have any questions, comments or suggestions in furtherance of the prosecution of this application, the Examiner is invited to contact the attorney of record by telephone, facsimile or electronic mail, as below.

Applicant believes that there are no fees due in association with the filing of this Response. However, should the Commissioner deem that any fees are due, including any fees for any extensions of time, Applicant respectfully requests that the Commissioner accept this a Petition therefor, and directs that any fees be debited from Baker Botts L.L.P. Deposit Account No. 02-0383, Order Number 075115.0109.

Respectfully Submitted,

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